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IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF OREGON

PORTLAND DIVISION

UNITED STATES OF AMERICA, Plaintiff, vs. W. JOSEPH ASTARITA, Defendant.	Case No. 3:17-cr-00226-JO **DEFENDANT'S POST-*DAUBERT* HEARING SUBMISSION**

I. INTRODUCTION

The government has repeatedly pointed out—and we agree—that perfect evidence is not always available to investigators; sometimes "non-ideal" evidence is the best they have to go on. But rather than recognizing the limits of its evidence, the government seeks to transform its

blurry video footage into two crystal clear diagrams that purport to be based on science, but in fact stretch science beyond its limits. The hearing revealed that the two critical questions that must be answered with respect to Deputy Turpen's and Mr. Terpstra's visual depictions of the scene are: (1) are the law enforcement agents/officers and Mr. Finicum's truck accurately and reliably positioned?; and (2) are the trajectory "cones" emanating from the Finicum truck accurate and reliable? As described in greater detail below, the testimony elicited from the defense *and* government experts establishes that the answer to both questions is a firm "no." Specifically, the evidence establishes that: (1) the government experts' methods are largely untested and unreliable; (2) those methods, even when faithfully applied, have inherent error rates that are not accounted for in the analyses; and (3) the erroneous *application* of those methods created additional material errors, for which the experts also failed to account.

II. DISCUSSION

A. Frank Piazza's Synchronization and Image "Sharpening"

1. Synchronization

Deputy Turpen's diagrams and Mr. Terpstra's model purport to position people and other objects at the precise moment at which the shot that struck the Finicum truck was fired. Both Turpen and Terpstra admitted that their analyses depend on accurately selecting the precise *frame* from the overhead FBI video that captures that moment. The government hired Frank Piazza to identify that frame by analyzing the "Cox video" and synchronizing that video with the FBI video. Mr. Piazza's audio/visual work is just one of his three businesses; he also records music and serves as a "voiceover" coach. Mr. Piazza has no college degree. He never submitted a meaningful report documenting his methods and failed to maintain notes of his work or screen captures documenting his settings on any of the (at least three) software programs he used.

In its brief, the government promised that Mr. Piazza would testify that his sync "may be off by a frame *at most*, and likely less" (emphasis in original). But Mr. Piazza admitted on direct examination that his sync might actually be off by as many as *ten* frames in either direction. On cross-examination, that error rate expanded to *eleven* frames in either direction (a 23-frame range).[1] And another government expert, Professor Jeff Smith, was only willing to label as "reliable" a synchronization range of *34* frames. This is critical because the positions of *all* of the individuals in those frames—not just Special Agent Astarita—are essential to understanding who may have been in a position to shoot. And during the 34-frame loop that the government played during the hearing, several people were seen materially changing position, underscoring the need to identify the precise frame depicting those individuals' positions when the key shot was fired. But neither Mr. Piazza, Dr. Smith, nor any other expert was able to do so.

2. Sharpening

Mr. Piazza "corrected" the color and "enhanced" the sharpness of certain FBI video images, and the government wishes to present those modified images to the jury. Defense experts Bruce Koenig's and Eugene Liscio's unrebutted testimony (supported by the graphic below, which reveals the problem in the upper right corner) was that, by doing so, Piazza's software tools decided where to create "edges" for objects and modified certain pixels at these locations to create more distinct objects out of blurry ones.

[1] Mr. Piazza conceded that, although his synchronization error was discovered in frames after the shots were fired, his error rate would have to apply to the *entire* synchronization.

Defense experts explained how these modifications bear directly on, for example, the important issue of who was in motion and who was not during key moments. But Piazza kept *no record* of what he did or how he did it, making it impossible to repeat his method to determine precisely what he eliminated and modified. That alone is reason to strike his testimony.

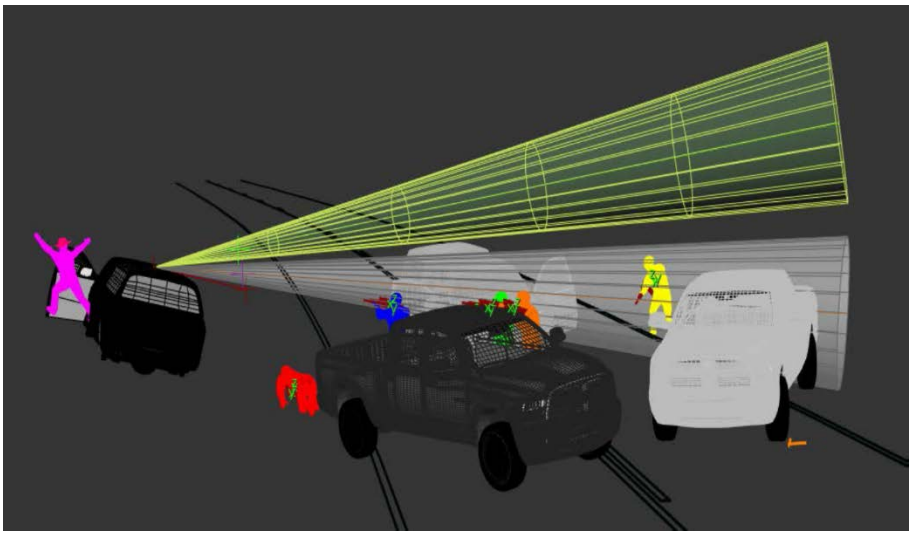
B. Trajectory Analysis

1. Victoria Dickerson's "Centering Cone" Method

The evidence established that Ms. Dickerson's trajectory measurement (which was incorporated into Deputy Turpen's diagrams) is unreliable for two main reasons. First, as Ms. Dickerson and Mr. Noedel explained, by placing a "centering cone" in Defect W, Ms. Dickerson necessarily *assumed* that the bullet passed through the *center* of the defect, even though Defect W was nearly *twice* the width of the .223 caliber round that the government alleges created that defect. The government did not present evidence that the method satisfies *any* of the *Daubert* factors: there is *no* evidence that the method has been tested or subjected to peer review, that it has a known error rate, that there are published standards governing its application, or that it is generally accepted in the field. Indeed, the Oregon State Police do not have a standard operating procedure for the use of centering cone trajectory analysis.

Second, as both Ms. Dickerson and government expert Michael Haag acknowledged, Ms. Dickerson's method—passing a trajectory rod through both Defect W and one of three holes

under the roof's insulation and liner—measured (albeit imprecisely) the bullet's trajectory *after* it struck the roof and deflected, rather than *before* it struck the roof. The importance of that distinction is apparent in Ms. Dickerson's estimation of the vertical angle of the shot (depicted in yellow, below), which passes far over the heads of *all* of the potential shooters:



Ms. Dickerson brushed aside the significance of that deflection error by baldly asserting—with no forensic or other supporting evidence whatsoever—that although the round clearly deflected *vertically*, it did *not* deflect *horizontally at all*. But government expert Michael Haag's book makes clear that there is no basis for such an assumption:

> *Deflection* as a consequence of *perforating, penetrating, or striking an object* describes deviations in *any* direction from the projectile's normal flight path as a consequence of perforating or striking an object rather than rebounding off its surfaces. For example, a bullet may be *deflected* by passage *through* a tree branch, a windshield, or a panel of sheet metal, but this does not represent an instance of ricochet. Since such deflection can occur in any direction in the examples cited (up, down, right, or left), its clock position is used to describe it. As viewed from the shooter's position (or the position directly behind the projectile at impact), 12 o'clock is taken as straight up relative to the horizontal plane at the location of the event; 3 o'clock is directly to the right; 9 o'clock is directly to the left, and so forth.

In short, as Matt Noedel explained and Mr. Haag acknowledged, Ms. Dickerson's estimate of *post*-impact trajectory (which is itself flawed because of the "centering" process) is not a reliable proxy for the bullet's *pre*-impact path, which is the only path that matters.

2. Michael Haag's "Rocker Point" Method

Implicitly recognizing his disagreement with Ms. Dickerson's method, Mr. Haag measured the bullet's pre-deflection trajectory by using his "rocker point" method. But Mr. Haag admitted—and Mr. Noedel confirmed—that unlike the more reliable "two-point" method, his rocker point method relies heavily on the "subjective feel" of the examiner. Ms. Dickerson testified that the Oregon State Police do not have a standard operating procedure describing the method, nor was she even aware of it until Mr. Haag trained her in October 2016. Mr. Noedel confirmed that the method is not described in any detail in the literature or generally accepted in the community, and Mr. Haag admitted that it is not even described in his *own book or training materials*. According to Mr. Haag, the method—which in this case involved the use of duct tape and a clamp—is a "minor technique" amounting to only a "small part" of the classes he teaches.[2]

Mr. Noedel explained that the method's reliability is further undermined by its extreme sensitivity to small errors. Because (as Mr. Haag confirmed) only approximately 1 centimeter of the trajectory rod's tip is used to take the measurement, even miniscule mistakes can result in dramatic errors: Mr. Noedel explained that a one-millimeter error (roughly the diameter of the point of a pencil) can throw off the measured trajectory angle by *14 degrees*.

3. Ms. Dickerson's and Mr. Haag's Plus-or-Minus 5 Degree Certainty

Ms. Dickerson assumed that a ± 5° margin of error applied to her centering cone measurements. But the record is utterly devoid of *any* support for that assumption, and Ms.

[2] The Hueske book cited by the government describes using the "shoulder" portion of a defect to measure shallow angle impacts to car metal, but Hueske does not describe any step-by-step process or procedure for doing so. The 2016 Mattijssen and Kerkoff study assessed the ability of six different examiners to precisely and accurately measure nine known vertical angles using the so-called "lead-in method." This method was *not* used to measure any known azimuth angles. In addition, the authors specifically cautioned readers against extrapolating their results to car metal.

Dickerson herself did not cite any foundational basis for relying on this error rate. None of the government's experts offered any studies, tests, or other evidence of the error rate that should properly be applied to centering cone measurements.

Similarly, there are no reliable, statistically valid data supporting the application of a ± 5° margin of error to Mr. Haag's rocker point method. In its brief, the government relied primarily on a 2008 paper authored by Mr. Haag ("2008 Study") to support that error rate. But as defense expert Dr. Andrew Bray testified, the 2008 Study was plagued by fatal structural and statistical errors: (1) lack of "blinding" (*i.e.*, students knew the answers before taking their measurements); (2) conditions were not held constant (*i.e.*, no way of knowing which or how many of the ~ 450 shots were measured using the rocker point method versus some other method, were fired into sheet metal versus some other medium, were fired at shallow versus steep angles, etc.); (3) contrary to NIST recommendations, "outlier" values were simply discarded from the dataset; (4) operations were mis-ordered;[3] (5) the study failed to take a *weighted* average of results across all of the various scenarios; and (6) Mr. Haag improperly assumed that his results followed a bell-shaped, or "Gaussian," distribution.[4]

Although Mr. Haag testified that he *agreed* with many of Dr. Bray's criticisms of his study and the way in which he handled his data, Mr. Haag stubbornly stood by his ± 5° margin of error assumption for two reasons, neither of which was supported by any reliable, statistically valid data. First, Mr. Haag pointed out that he and others used that standard even before he

[3] As an example, Dr. Bray explained that if students measured a known 35° angle as 20°, 30°, 40°, and 50°, Mr. Haag's method would improperly take the *average* of those measurements (35°) and conclude that the average measurement error was 0°!

[4] The government criticized Dr. Bray for not conducting his own statistical analysis of the data to derive an appropriate margin of error. But as Dr. Bray explained, the fundamental errors in the way the data were collected made it *impossible* to do so.

published his 2008 paper. But as Mr. Noedel explained, the evolution of that "standard"—derived from little more than folklore derived from people connecting *two points* with string and pencils in walls—only highlights how *necessary* the 2008 Study was in introducing statistical rigor to a field that did not have it before. Mr. Haag wrote his paper for a *reason*, and without it, the empirical support for the standard collapses. Second, Mr. Haag contended that his ± 5° margin of error is supported by the 19 shots he fired into sheet metal in preparation for the hearing, each of which he apparently measured within 5° of the true value. But the Court should be suspicious of the results of a test performed by the leading proponent of the method, specifically for purposes of the litigation at hand, without any blinding. Moreover, despite the cautionary note in Mr. Haag's 2008 Study that "[g]ood scientifically defensible methods often require an in-depth statistical analysis," Mr. Haag failed to offer *any* statistical analysis of those 19 shots. In order to calculate a reliable margin of error, Mr. Haag would have had to consider the distribution of the data points, calculate an appropriate standard deviation, and apply other applicable statistical criteria. Mr. Haag did *none* of this. Mr. Haag's 2008 Study also notes that "a larger cone [than ± 5°] may be necessary for shallow angle shots" like those at issue here. But there are no reliable studies establishing what the size of that cone should be.

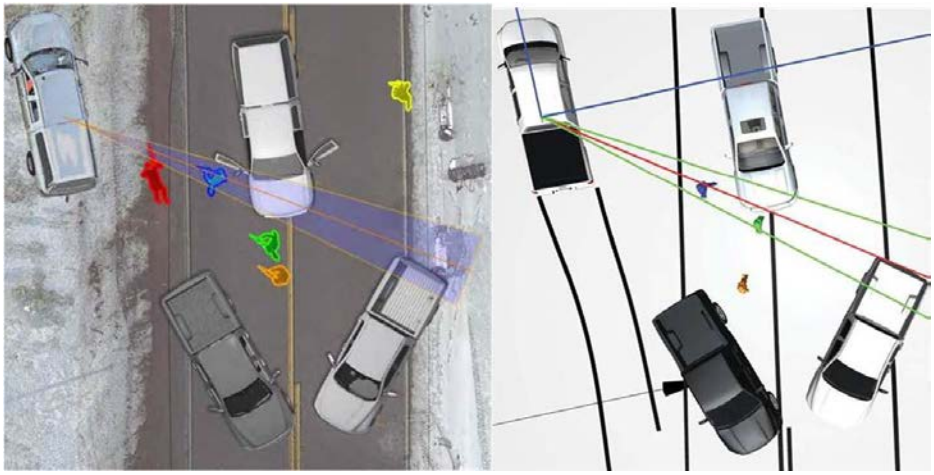
C. Deputy Kevin Turpen's Diagrams

Although Deputy Turpen relied on "total station" measurements to place certain items in his diagrams, he admitted that he did *not* place the items that matter most—Finicum's truck and the individual people—by using total station measurements of their positions at the time of the shooting. Rather, Finicum's truck appears in Turpen's diagram in the position it was in *9 to 14 hours after* the shooting. Turpen did nothing to account for another investigating officer's observation that the truck's left rear wheel had sunk into a "large depression" shortly after the shooting, likely resulting from the drive wheel spinning for some time. Turpen also

acknowledged that: (1) he personally witnessed the truck settle by 3-4 inches just during his time on the scene; (2) the truck likely settled *unevenly* because of numerous factors (*e.g.*, hot engine, uneven weight of various parts of the truck, passengers shifting inside and ultimately exiting out a single door); and (3) the rear wheels of the truck were not encased in snow and could have slid laterally. As Ms. Dickerson testified, there was no way to measure or determine how much Finicum's truck had settled side-to-side. Nevertheless, Turpen admitted that neither he nor any other investigator took any measurements or otherwise analyzed how all of that movement affected the position of the truck in the many hours between the shooting and the total station measurement 9 to 14 hours later. And Turpen did not build *any* margin of error into his diagrams to account for that movement even though, as Mr. Liscio explained, even a few inches of movement could have dramatically shifted the trajectory line depicted in the diagrams.

With respect to the placement of the *individuals* in his diagrams, Deputy Turpen admitted on cross-examination that his methodology—consisting of placing people as "best he could" based on visual cues from an unidentified video frame shot from two miles away—does not satisfy *any* of the *Daubert* factors. None. And although he admitted that one must know which *frames* of video he relied on in order to properly evaluate the accuracy of his method, Turpen conceded that he did not keep any record of that and cannot tell us what frames he used, making it impossible to recreate his work. He also admitted that he did not rely on Mr. Piazza's work, but rather on a video synchronization performed by Zach Neeman, whose methods are not explained anywhere in the record. And while admitting that there is error inherent in his subjective placement of individuals in his diagrams, Turpen acknowledged that his diagrams do not account for any margin of error whatsoever. Finally, he was unable to account for the

material differences in the individuals' positions in his diagram (below right) versus Mr. Terpstra's model (below left):



D. Toby Terpstra's Model

1. Mr. Terpstra's Testimony

Although Mr. Terpstra claims to have used "photogrammetry," he is admittedly not an expert in that field; he is an animator with no bachelor's degree in any discipline, much less in any field of forensic science. He also conceded that, while he may have used millions of datapoints to create an accurate depiction of the road and other landmarks (the chessboard, essentially) and to construct models of the trucks (some of the chess pieces), the critical task of *arranging the pieces* (the people and trucks) on that board was a *manual*, *subjective* process.

Terpstra also conceded that he used the *wrong frame* from the FBI video as the foundation of his analysis, a problem that, by his own admission, renders *every significant diagram in his report unreliable*. He did not, as he claimed in his report, rely on Mr. Piazza's synchronization to choose that frame. Instead, he relied on a synchronization whose methods and error rates are not described anywhere in the record. And he admitted that, even if he had used Mr. Piazza's sync, his model failed to account (and *should have accounted*) for where each

individual was located over the *entire error range* identified by Mr. Piazza, not merely the one (wrong) frame Mr. Terpstra analyzed.

Furthermore, in creating his model, Terpstra admittedly did not apply his "camera matching" method correctly:

- He admitted that: (1) he relied on lane markers for his matching without realizing that those markers had *changed* since the time of the shooting; (2) this affected the accuracy of his model; but (3) he *could not quantify* this error.

- Studies cited by Terpstra *in his own report* emphasize that "the accuracy [of camera matching] depends on the ability of the user to accurately place the [virtual] camera in the *correct position* with the *correct focal length*" (emphasis added). Nevertheless, Terpstra admitted that with respect to the FBI Video—the one picture that really matters—he placed his "virtual camera" over *3,500 feet* away from where it should have been and assumed a focal length that was completely wrong. He conceded that there is absolutely nothing in the literature to suggest that erroneous camera positioning and focal length do not matter so long as the virtual camera is placed along the same line of sight as the actual camera. To the contrary, Terpstra *demonstrated* that changing a camera's distance and focal length can distort the resulting image even if the camera remains on the same line of sight with the correct camera positioning. But his model in no way accounts for this error.

- He agreed that his analysis assumes that the truck remained in precisely the *same position* during the entire 20-minute period during which the 12 photos used for his camera matching were taken after the shots were fired. He had no idea that the truck had *settled* in the snow after Round 5 was fired and did not take this fact into account at all.

- Although Terpstra has written at least three papers cautioning about errors that can result in camera matching when *lens distortion* goes uncorrected, he admitted that he: (1) did *not* correct for lens distortion in nine of the twelve images used in his analysis; (2) omitted this fact from his report; and (3) does not know anything about the FBI cameras that might support his assumption that it was safe to completely ignore lens distortion instead of correcting for it.

Finally, even if Terpstra had faithfully applied accepted camera matching techniques, he admittedly failed to account for significant errors that are inherent in those techniques. He admitted that, although his report does not assume any accuracy errors *at all*, camera matching itself *does* have an error rate—some distance between where camera matching *says* an object is versus where it *actually* is. He further conceded that the applicable error rate changes from

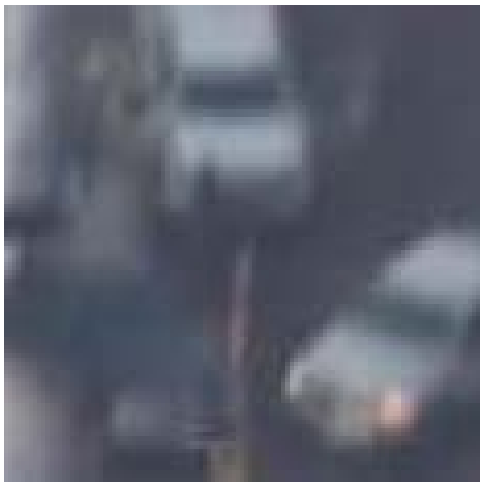
scenario to scenario, photograph to photograph, and object to object. For example, the "Coleman Study" cited in Terpstra's report—which relied on much clearer pictures than those at issue here, taken at much closer ranges—*still* recorded errors of up to 19.6 cm (nearly 8 inches). Mr. Terpstra's *own* study, which he discussed when he was recalled to the stand, relied on measurements taken by multiple professional photogrammetrists employed by Mr. Terpstra's company, each of whom believed they had used camera matching to "align" the photographs correctly, exactly as Terpstra claims to have done here. Again, the images in that study were of much higher quality, and taken at much closer ranges, than the images at issue in this case. Despite all of that, the average error rate among those professional photogrammetrists was *13 inches* (33cm). But Mr. Terpstra did not build in an error rate of 8 or 13 inches into his analysis. He admittedly did not build in *any error rate at all*, instead inexplicably assuming that the error rate was zero.[5]

2. Eugene Liscio's Testimony

Unlike Terpstra, Eugene Liscio is a licensed Professional Engineer and trained 3D forensic analyst who holds a Bachelor of Engineering degree. Liscio testified that camera matching is at the bottom of his "hierarchy" of available tools—a "last resort" that amounts to "a completely subjective process" and which, unlike analytical photogrammetry, "does not provide any mathematical means of calculating the accuracy of the final result." As a result, Liscio explained, "gross errors [for which Terpstra failed to account] are possible" and, while things in the model may *appear* to be "lined up," "we could be fooled."

[5] Terpstra admitted that his "range of certainty" is *not* an error rate. Rather, it is a rough measure of *precision* (how much he could "wiggle" the model with it still subjectively looking right to him), rather than a measure of *accuracy* (how far away Terpstra is from the *right* answer).

Liscio also testified (and demonstrated) that the blurry FBI image shown below, taken at a distance of nearly two miles, was a very poor candidate for camera matching, contributing even further to the subjectivity of Terpstra's exercise:



Liscio also explained that camera matching simply *does not work* with respect to objects—like Finicum's truck in the snowbank—that are "floating" above scanned surfaces. Camera matching "solutions" for such objects may appear to "align," but cannot be assumed to be accurate. And he testified that there were "grave discrepancies" between Terpstra's camera matching results and total station data collected by Terpstra (*e.g.*, with respect to roadway features) and by Deputy Turpen and his team (with regard to the Finicum truck). For example, with respect to the Finicum truck, the results do not match the total station data *even if one assumes that the government is right that the truck settled in some precise, controlled manner*. This inconsistency is critical because, as Liscio described, even small errors in the orientation of the truck could result in dramatic changes to the horizontal azimuth angle depicted in the model.

Finally, Mr. Liscio explained that even if Terpstra could correct for the fact that he analyzed the wrong image, his camera matching technique would not become any less subjective, his results would not be any more reliable, and Terpstra would not be any more able to quantify the many accuracy errors inherent in his model.

3. Clifford Mugnier's Testimony

Clifford Mugnier holds a bachelor's degree in physics, geography, and mathematics, and a master's degree in advanced photogrammetry. He was a pioneer in the field of photogrammetry and has been working exclusively in that field for approximately 40 years. He is familiar with the use of computer-aided photogrammetry, even authoring one of the early computer programs in the field. Mr. Mugnier testified that, although the particular software programs and other tools of the trade may have changed over time, the mathematical principles underlying the discipline have not.

Mr. Mugnier also testified that Terpstra's camera matching technique is a "subjective way of guesstimating" and simply uses the eyeball to check whether it's "plausible" if something appears to match. Mugnier further explained that, while things may appear to "line up" after the camera matching is complete, the results may be inaccurate without one even realizing it. To illustrate that principle, Mugnier demonstrated how a simple stereoscope revealed obvious errors in Terpstra's camera matching. The government ridiculed that demonstration, but Mugnier explained that the failure of Terpstra's method to pass even that basic test reflects fundamental flaws with the method. The method is, Mugnier explained, "subjective graphic art," not science.

Finally, Mr. Mugnier explained that it is *mathematically impossible* to reliably place an object (like the Finicum truck) in a model like Terpstra's unless the object is touching a "plane of rectification" (*i.e.*, a flat surface) that has been scanned. Because the snowbank on which the Finicum truck was sitting was *not* scanned, the truck *cannot* be reliably placed in the model—even if it looks as if it is "aligned" to a photograph.

4. Professor Smith's Testimony

Professor Smith's expertise is primarily in audio forensics and the authentication of multimedia recordings. He does not do casework in accident reconstruction, is not a

photogrammetrist, does not perform camera matching, and has never testified about photogrammetry or camera matching. Professor Smith's testimony seemed aimed largely at blessing in broad strokes the work done by various of the government's other experts. He generally endorsed the government's refrain that "in forensics, it is normal to encounter non-ideal data," but agreed on cross-examination that just because non-ideal data is common, such data does *not* always lead to reliable and accurate results. Specifically, he testified that "I wouldn't want to say that any data should be considered for any case." With regard to the work of specific experts, Smith agreed that Piazza's synchronization was "reliable" but clarified that what he meant is that the synchronization was reliable *within a 34-frame range*. Similarly, he testified on direct that Terpstra's method is reliable because it includes a "computationally-aided foundation." But on cross-examination, he admitted that what he meant by this is only that Terpstra used a computer and a laser scanner to build his 3D landscape and 3D trucks (the chessboard and pieces). He admitted that the most important portion of Terpstra's work—*placing* the trucks and people *into* the scene—was a purely subjective exercise.

DATED this 1st day of June 2018

Respectfully submitted,

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